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In a recent paper[1], I explored the effects, on the conventional measures of distribution of income among households, of demographic elements, such as the size and changing composition of households through their life cycle. The exploration emphasized the need for taking explicit account of these demographic elements in any attempt to observe trends in the long-term levels of income differentials--particularly those associated with economic growth, since the latter is usually accompanied by marked shifts in the size and age-of-head distributions of households. Of particular interest was the negative association between per capita income and size of the household or family, found also within the age-of-head classes and thus persisting through the household's lifespan. If this cross-section association is translated into comparisons of per capita income for households of differing average size over the lifespan, the result is a negative association between the per capita income and size variables. Since, in turn, size of households or families is largely a function of the number of children, the negative association just noted is also one between lifetime per capita income and fertility--provided that the differentials in fertility dominate differentials in mortality, as they did in the small sample of countries for recent years used in the cross-section in the recent paper.

The present paper deals with a different, if related, question. Given the major population trends observable in recent decades in the economically less developed countries (LDCs), what can one infer as to the possible effects on long-term levels or changes in them in the internal distribution of income? For obvious reasons of scarcity of relevant data, and even more of the complex interactions between the population trends

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and the concurrent structural changes in the economy and society of the countries involved, any answer to the question just raised is bound to be speculative. But there may be value in at least trying to formulate the question unambiguously, and in attempting some explicit, relevant, speculation.

1. The Major Population Trends

One must begin by stressing that the acceleration in the population growth rate in the LDCs, and their markedly higher rate of natural increase than in the economically developed countries (DCs), are recent historical trends--as is clearly indicated in Table 1. Such recency, and the brevity of the period over which these trends prevailed so far compared with the preceding centuries of quite different domographic patterns, are basic to the understanding, and evaluation, of both the trends and their implications.

Table 1 shows that form the mid-18th century and through 1920, the rate of increase (overwhelmingly, of natural increase) in the LDCs was at relatively low level, varying from less than a tenth to about five-tenths of a percent per year (see column 5, lines 12-24).[2] Throughout this long period of some 17 to 18 decades, the population growth rate in the DCs was substantially higher--ranging from over four-tenths to well over 1 percent per year; and showed a marked acceleration already in the first half of the 19th century. It is only since the 1920s that the rates of natural increase in the LDCs rose to approach those in the DCs; began to exceed the latter in the 1930s and 1940s, when severe economic recession and then World War II reduced population growth in the developed countries; and only since the 1950s did the annual growth rates of the LDCs climb to well over 2

Table 1: Growth of Population, Economically Less Developed (LDC) and Developed (DC) Countries, 1750-1975

		World (1)	DCs (2)	LDCs (3)	China (4)	Other LDCs (5)
		A. Absoulte Totals, in million				
1.	1750	791	201	590	200	390
2.	1800	978	248	730	323	407
3.	1850	1,262	347	915	430	485
4.	1900	1,650	573	1,077	436	641
5.	1920	1,860	673	1,187	476	711
6.	1930	2,069	758	1,311	502	809
7.	1940	2,295	821	1,474	533	941
8.	1950a	2,515	858	1,658	563	1,095
9.	1960a	2,998	976	2,022	654	1,368
8b.	1950b	2,501	857	1,644	558	1,086
9b.	1960b	2.986	976	2,010	654	1,346
10.	1970	3,610	1,084	2,526	772	1,754
11.	1975 (proj. med. var.)	3,967	1,132	2,835	838	1,997
		B. Rates of Increase (per year, per 1,000)				
12.	1750-1800	4.3	4.2	4.3	9.6	0.9
13.	1800-1850	5.1	6.7	4.5+	5.2	3.5-
14.	1850-1900	5.4	10.6	3.3	0.3	5.6
15.	1900-1950	8.4	8.1	8.3	4.9	10.7
16.	1950-1975	18.6	11.2	22.0	16.4	24.7
17.	1900-1920	6.0	8.1	4.9	4.4	5.2
18.	1920-1930	10.8	12.0	10.0	5.3	13.0
19.	1930-1940	10.4	8.0	11.8	6.0	15.2
20.	1940-1950	9.2	4.4	11.8	5.5-	15.3
21.	1950-1960	17.7	13.0	20.0	15.1	22.5-
22.	1950-1960	17.9	13.1	20.3	16.0	21.7
23.	1960-1970	19.2	10.6	23.1	16.7	26.8
24.	1970-1975	19.0	8.7	23.3	16.5+	26.3

Notes to Table 1

DCs include Europe, USSR, North America, Temperate South America (Argentina, Uruguay, Chile), Australia, and New Zealand. LDCs include all other.

Lines 1-4: from United Nations, The Population Debate: Dimensions and Perspectives, Volume I, New York 1975, Table 1, pp. 3-4; and the original paper by John Durand cited there. The estimates for China here are from the Durand paper.

Lines 5-9a United Nations, World Population Prospects, New York 1966 Table A.3.1, p. 133.

Lines 9b-11: United Nations, Selected World Demographic Indicators, 1950-2000, mimeo. working paper ESA/P/WP.55, May 1975.

Lines 12-16: Calculated from lines 1-4, 8b, and 11.

Lines 17-21: Calculated from lines 5-9a

Lines 22-24: Calculated from lines 8b-11.

percent, while those in the DCs declined by the early 1970s to less than 1 percent. Thus, the acceleration and growth excess of population movements in the LDCs were within a relatively short span of about five decades, following centuries of growth at low rates that would look like stagnation by modern standards.

The second important aspect of these recent trends is that the acceleration, and the resulting excess in the rates of natural increase in the LDCs over those in the DCs, was due wholly or almost wholly, to the decline in the death rates--rather than to any movements in the birth rates. A summary of the trends of these vital rates taken separately, but unfortunately limited to the years since 1937, is presented in Table 2. Part of this table refers to observed changes, to 1970-75[3]; the other part refers to projections to the year 2000. We deal with the observed changes first.

Between 1937 and 1970-75, a span of about 35 to 36 years, the rise in the rate of natural increase for LDCs (excluding China) from 11.7 to 26.1, or some 14.4 points resulted from a combination of a decline in the crude death rate from 30.8 to 16.0 or 14.8 points, and a drop in the birth rate of only 0.4 points. A similar dominance of the drop in the death rate as the overwhelming factor in the rise in the rate of natural increase over the period from 1937 to 1970-75 is true also of LDCs including China (for both comparisons see lines 15-20, columns 2 and 5). By contrast, whatever movements occurred in the rate of natural increase in the DCs have been due at least as much to declines in birth rates as they were to declines in death rates (see lines 12-14, columns 2 and 5).

It is interesting to estimate the trend were we to extend the view to 1920, the date that is the dividing line prior to the acceleration in the growth rate of LDC populations. In line 17 of Table 1 we observe that

Table 2 Growth Trends and Vital Rates (per 1,000), Observed 1971-1975, and Projected 1975-2000

A. Absolute Totals and Growth Rates

		1937 (1)	1955 (2)	1975 (3)	1985 (4)	20000 (5)
	Total, million					
1.	World	2,255	2,722	3,967	4,816	6,253
2.	DCs	802	915	1,132	1,231	1,361
3.	LDCs	1,423	1,808	2,835	3,585	4,893
4.	LDCs, ex. China	899	1,203	1,997	2,612	3,745
	Rates of Increase, per Year, per 1,000 Successive Intervals					
5.	World		11.3	19.0	18.6	17.6
6.	DCs		7.4	10.7	8.4	6.7
7.	LDCs		13.4	22.7	23.8	21.4
8.	LDCs ex. China		16.3	25.7	27.2	24.3

B. Vital Rates, Levels and Changes

		1937 (1)	Change to 1950-55 (2)	1950-55 (3)	Change to 1970-75 (4)	1970-75 (5)	Change to 1995-00 (6)	1995-2000 (7)	Total Change (8)
	World								
9.	CBR	35.8	-0.2	35.6	-4.1	31.5	-6.4	25.1	-10.7
10.	CDR	25.7	-6.9	18.8	-6.0	12.8	-3.9	8.9	-16.8
11.	CRNI	10.1	+6.7	16.8	+1.9	18.7	-2.5	16.2	+ 6.1
	DCs								
12.	CBR	24.1	-1.2	22.9	-5.7	17.2	-1.6	15.6	- 8.5
13.	CDR	15.5	-5.4	10.1	-0.9	9.2	+0.7	9.9	- 5.6
14.	CRNI	8.6	+4.2	12.8	+4.8	8.0	-2.3	5.7	- 2.9
	LDCs								
15.	CBR	42.5	-0.4	42.1	-4.6	37.5	-9.7	27.8	-14.7
16.	CDR	31.6	-8.3	23.3	-9.0	14.3	-5.7	8.6	-23.0
17.	CRNI	10.9	+7.9	18.8	+4.4	23.2	-4.0	19.2	+ 8.3
	LDCs ex. China								
18.	CBR	42.5	+2.0	44.5	-2.4	42.1	-11.3	30.8	-11.7
19.	CDR	30.8	-6.4	24.4	-8.4	16.0	-7.1	8.9	-21.9
20.	CRNI	11.7	+8.4	20.1	+6.0	26.1	-4.2	21.9	+10.2

Notes to Table 2

Panel A: The estimates for 1937, lines 1-4, col. 1, are logarithmic interpolations between the totals for 1930 and 1940 shown in lines 6-7 of Table 1 above. The other entries in lines 1-4 are from the source used for Table 1 lines 8-b 11, with the use of the medium variant projection throughout.

The rates of increase in lines 5-8 are from lines 1-4, with due allowance for the varying durations of the intervals (which are 18, 20, 10, and 15 years respectively).

Panel B:

Col. 1: Data from United Nations, World Population Trends, 1920-1947 New York, December 1949; Table 2, p. 10 shows the vital rates, and we took the mid-value of the ranges shown. DCs here comprise North America, Japan, Europe, and Oceania (but exclude Temperate South America, a minor omission here and a minor inclusion under the LDCs). China is identified with "Remaining Far East" (after exclusion of Japan). The population weights used to combine the rates are in the source, Table 1, p. 3.

Cols. 2-8: Based on data from the UN working paper, used for lines 8b-11 of Table 1 above (on Selected World Demographic Indicators by Countries, 1950-2000.)

the growth rate per year for LDCs for 1900-1920 was about 0.5 percent per year, meaning a rate of natural increase of 5.0 per 1,000. Assuming that the crude birth rate in 1900-1920 averaged about the same as in 1937 (viz., 42.5 per 1,000), we would obtain an implicit crude death rate for 1900-1920 of 37.5 per thousand--compared with a CDR in 1937 between 31 and 32 per thousand. If we assume that the recent downward trend in the crude death rate for the LDCs did not begin until the 1920s, the conclusion is that over a decade to a decade and a half prior to 1937, the drop in the CDR for LDCs was about 6 to 7 points per 1,000--of the same order of magnitude that was found in the somewhat longer periods from 1937 to 1950-5, and from 1950-5 to 1970-5 (see line 19, cols. 2 and 4). And while the calculation is obviously approximate, it is reasonable to conclude that the estimated decline in the crude death rates was most likely much greater over that period than any reasonably assumed change in birth rates.[4]

Using the evidence in Table 2, and the approximate calculations in the text, one may summarize by saying that over the fifty years terminating in 1970-75, i.e. between 1920-25 and the latter date, crude death rates in the LDCs must have declined from over 37.5 to between 14 and 16 per 1,000 (see Table 2, lines 16 and 19, co. 5); whereas the crude birth rates may have moved from 42.5 per 1,000 to either 42.1 (LDCs excluding China) or 37.5 (LDCs including China). The drop over the five decades was thus about 22.5 points in the crude death rate, and between 0.4 and 5 points in the crude birth rate--the rise in the rate of natural increase almost completely dominated by the down-trend in the death rate.

Several aspects of this recent decline in death rates in the LDCs should be noted. These and other aspects of what appeared to have been the major demographic revolution in world population have been widely

discussed in the literature[5]; but they deserve at least brief explicit mention here.

The first aspect of the recent declines in death rates in the LDCs is that they proceeded at a rate far exceeding that of the declines in death rates in the currently developed countries in their past. Table 3 illustrates the contrast, in comparison with the older European countries. A drop of 22.5 points in the rates in the LDCs over five decades meant a per decade decline of 4.5 points. For the five Northern European countries, the rates of decline per decade were, for the successive intervals in columns 5-7, 0.76, 0.84, and 1.80. For the other four European countries, the per decade declines in the death rates were 1.11 points for the interval 1850-1895, and 2.10 for the interval from 1895-1925. If the initial position of the LDCs in 1920-25 should be compared with that of the European countries either in 1800 or in 1850, the rate of decline in the LDCs over the first five decades of their demographic transition was from 4 to 5 times as high as that for the older, settled, currently developed European countries.

One should also note that, in the <u>earlier</u> phases of the shift in demographic patterns, the movements of the birth rates also in the currently developed countries were at rates much lower than those in the death rates--so that the initial rises in the crude rates of natural increase were, as in the case of the recent trends for the LDCs, due predominantly to the declines in mortality.

The second distinctive feature of the recent major drop in death rates in the LDCs is that it occurred in regions in which the basic economic and institutional structures were little affected by industrialization and modernization--whereas the trends in death rates that we observed for the currently developed countries in Table 3 occurred largely in as-

Table 3 Long Term Trends in Crude Vital Rates (per 1,000), Currently Developed Countries (for Comparison with Recent Trends in the LDCs)

	Levels of Vital Rates				Changes in Rates		
	1800 (1)	1850 (2)	1895 (3)	1925 (4)	1800-1850 (5)	1850-1895 (6)	1895-1925 (7)
Five Northern European Countries							
1. CBR	34.0	32.8	29.8	20.6	-1.2	-3.0	-9.2
2. CDR	25.2	21.4	17.6	12.2	-3.8	-3.8	-5.4
3. CRNI	8.8	11.4	12.2	8.4	+2.6	+0.8	-3.8
Four Other European Countries							
4. CBR	n.a.	31.5	30.0	21.2	n.a.	-1.5	-8.8
5. CDR	n.a.	25.0	20.0	13.7	n.a.	-5.0	-6.3
6. CRNI	n.a.	6.5	10.0	7.5	n.a.	+3.5	-2.5

Notes:

The averages in lines 1-6 are calculated from the vital rates summarized in Simon Kuznets, Modern Economic Growth, Yale University Press, New Haven, 1966, Table 2.3, pp. 42-44. Lines 1-3 include England and Wales, Denmark, Finland, Norway and Sweden; lines 4-6 include Belgium, France, Germany, and Netherlands. For all countries the year indicated represents the mid-point of a long interval over which the crude rates were averaged, the interval varying between six, four, or one decade. The entries represent unweighted arithmetic means of the values for the individual countries included.

The changes in columns 5-7 are derived directly from the averages in columns 1-4.

sociation with marked upward movements in per capita product and, more important, advances of the countries in the economic and institutional transformation associated with modern economic growth. This was certainly true beginning with the mid-19th century. And, one should add, both the rapidity of the recent decline in death rates in the LDCs, and its occurrence without association, in many of the regions involved, with any significant economic and institutional changes, can be credited to the nature of the technological revolution in dealing with infectious diseases and with the major health problems of the LDCs, which apparently began after World War I, and reached its most striking successes shortly after World War II.

Third, granted the importance of major innovations in the technology related to control of diseases and of mortality, and the pervasive impact of declines in mortality on LDC regions and countries differing widely in institutional and economic structure, complementary effects of other technologies were required and differences in exposure to modernizing influences continued to affect death rates. After all, the new medical and public health tools had to be made accessible to all population groups in the LDCs to produce the wide effects observed (see comment below); here, the technological revolution in transport and communication played an important role. And differences in extent and duration of exposure to modernizing influences are reflected even now in death rate differentials among major groups of LDCs (and would be even more prominent in single country comparisons). Thus, Table 4 below shows that even by 1970-75 crude death rates in Subsaharan Africa (excluding the Southern region) were, at 22 per thousand, over twice as high as those for Latin America (excluding the Temperate Zone) at somewhat over 9 per thousand.

Finally, one should note that declines in death rates (as in other vital rates) of the magnitude suggested for the LDCs over the last fifty years--and perhaps even for each of the quarter century subperiods separately--mean that the demographic trends involved must have necessarily affected large proportions of the total population involved. For each of these vital rates is a weighted average of group specific rates, weighted by the groups' proportions in the total. Thus, a decline in the crude death rate of a few points, say from 32 to 30 per 1,000, could well be accounted for by a decline of 6 points occurring for a group whose mortality declined from 32 to 26 per 1,000 while that of the remaining group stayed constant--the two groups accounting for one-third and two-thirds of the total population respectively. But a much larger decline, and conditions in which the death rate of a small group in the total population cannot be sharply reduced while mortality remains high in the rest of the population, mean that the impact of the decline must necessarily have been widespread. This point is of analytical importance, considering the contrast between the sharp downtrends in the death rates and the minor declines in birth rates--with implications for the possible differential impacts of the two sets of trends on the various groups in the population, particularly the smaller economic and social groups at the top and the much larger proportions of the population at middle and below average economic and social levels.

In turning now to the sections of Table 2 that relate to population and vital rate <u>projections</u> to year 2000, we may view the latter as informed judgments of the likely domographic trends--on the assumption that no great catastrophies or miraculous boons introduce major discontinuities, and the more interesting assumption that economic and social progress will be at a feasible pace to warrant expectation that the growing populations

will be sustained at acceptable levels.[6] From our standpoint, the major interest in these projections is their indication that while the growth rates and the vital rates in the developed countries will move slowly downwards over the last quarter of this century--and show no declines in the death rates, for LDCs (excluding China) death rates will still decline substantially (see line 19, col. 6). And while the birth rates for the LDCs are assumed to drop even more (see line 18, col. 6), the projections for the last quinquennium still show a rate of natural increase over 2 percent per year, and well above the initial rates either in 1937 or even in 1950-55.

But given the large magnitudes of, and some significant disparities within, the total of LDCs, it is useful to consider the magnitudes and projections separately for the major LDC regions--and with some time break from 1970-5 to 1995-2000 (Table 4). The total LDC population for 1975 accounted for in this table can be compared with that in Table 2 above, for LDCs excluding China--and it is 1,918 million compared with 1,997 in line 4, col. 3 of Table 2.

One should begin by noting the dominance of the South Asia region in the 1975 total, and the Asian contribution would become all the larger were we to include China. In 1975, the population for China implicit in Table 2 is 838 million. Of the total for South Asia, the contribution of what might be called the clearly Hindic group (Bangladesh, Pakistan, and India) was 758 million. Thus, of the total in 1975 of the four regions shown in Table 3 plus China, viz. 2,756 million, as much as 1,596 million was accounted for by the two areas that could be designated as centers of the centuries-old Sinic and Hindic civilizations. Of the total additions over the twenty five year interval from 1975 onwards, some 1,984 million,

310 million are projected for China (see Table 2) and another 593 million for the three Indian countries listed above. Thus by the year 2000, the areas that are the centers of these two old civilizations would still account for 1,148 plus 1,351 billion, or a total of some 2.5 billion out of an aggregate for all LDCs in the four regions of 4.74 billion. The emphasis on this large contribution of these two old civilizations to the population bulk, and current and projected excess growth of the LDCs, points to a consideration of the past economic and social innovations that permitted the sustained growth of this population mass on an area far smaller than that occupied by the other LDCs--innovations in agriculture, and institutional devices, that would presumably affect the responses of the relevant populations to the declines in the death rates, and to the changing role of the next generation in the adjustment to widening economic opportunities associated with industrialization and modernization.[7]

There were marked differences among these groups in the levels of death rates in 1950-55, the earliest quinquennium for which the comparison is easily feasible. In Latin America, these death rate, were as low as 15.2, as result of preceding declines that proceeded at a slow pace to the 1930s, and accelerated thereafter.[8] In the same quinquennium, the crude death rates ranged from 22 1/2 to 28 1/2 per thousand in the three other LDC regions. With the crude birth rates at roughly similar levels, the result was a substantial range in rates of natural increase, from 19 to 28 1/2 per thousand.

Over the twenty five year period to 1975, there were substantial declines in the crude death rates in all four LDC regions, leaving the differentials in death rates in 1975 even wider, at least proportionally, than they were in 1950-55 (see column 3, which shows a range from 9.3 for

Table 4 Vital Rates (per 1,000), Observed (to 1970-75) and Projected (to 1995-2000, Medium Var.), LDC Regions

	1950-55 (1)	Change to 1970-5 (2)	1970-75 (3)	Change to 1980-5 (4)	1980-85 (5)	Change to 1995-00 (6)	1995-2000 (7)	Total Change (8)
East and Middle South Asia (1,162; 2,093)								
1. Crude B.R.	44.1	-2.2	41.9	-3.5	38.4	-10.2	28.2	-15.9
2. " D.R.	25.2	-8.7	16.5	-3.8	12.7	-3.9	8.8	-16.4
3. " RNI	18.9	+6.5	25.4	+0.3	25.7	-6.3	19.4	+ 0.5
Middle East (196; 366)								
4. Crude B.R.	47.1	-4.0	43.1	-2.4	40.7	-9.1	30.6	-15.5
5. " D.R.	22.4	-7.6	14.8	-3.1	11.7	-3.8	7.9	-14.5
6. " RNI	24.7	+3.6	28.3	+0.7	29.0	5.3	23.7	- 1.0
Subsaharan Africa (275; 566)								
7. Crude B.R.	48.7	-1.1	47.6	-1.0	46.6	-4.7	41.9	- 6.8
8. " D.R.	28.6	-6.8	21.8	-3.6	18.2	-5.4	12.8	-15.8
9. " RNI	20.1	+5.7	25.8	+2.6	28.4	+0.7	29.1	+ 9.0
Latin America (ex. Temperate Zone, 285;567)								
10. Crude B.R.	43.7	-4.8	38.9	-2.3	36.6	-6.0	30.6	13.1
11. " D.R.	15.2	-6.0	9.2	-2.0	7.2	-1.9	5.3	-9.9
12. " RNI	28.5	+1.2	29.7	-0.3	29.4	-4.1	25.3	-3.2
LDCs (The Four Regions Above, 1,918; 3,592)								
13. Crude B.R.	45.0	-2.6	42.4	-2.8	39.6	-8.7	30.9	-14.1
14. " D.R.	23.9	-7.9	16.0	-3.4	12.6	-3.8	8.8	-15.1
15. " RNI	21.1	+5.3	26.4	+0.6	27.0	-4.9	22.1	+ 1.0

Notes to Table 4

The underlying data are all from the UN 1975 Working Paper cited in the notes to Tables 1 and 2 above.

The totals entered in parentheses following the designation of regions are the 1975 and year 2000 populations of the region, in million.

East and Middle South Asia is a combination of East South Asia and Middle South Asia. The internal weights, based on the 1975 population, are 3 and 7, for the two subregions respectively.

Middle East comprises Western South Asia and North Africa, with approximately equal weights.

Subsaharan Africa includes three subregions--Eastern Africa, Middle Africa, and Western Africa (with approximate weights of 4, 2, and 4). Southern Africa was omitted because of the weight in it of the Union of South Africa, and the mixed composition of its population with different levels of economic development.

Latin America comprises the Caribbean, Middle America, and Tropical South America, with approximate weights of 1, 3, and 6. The Temperate Zone (Argentina, Uruguay, and Chile) was omitted.

The total of LDCs is a weighted average of the four regions (with weights of 60, 10, 15, and 15, for the regions in the order listed).

For more detail concerning inclusion of individual countries see the source. China and East Asia, in general, are omitted; and so are some LDCs in Oceania.

Latin America to 21.8 for Subsaharan Africa) and the declines in the death rates were substantially larger than the declines in birth rates, leading to a rise in the rate of natural increase, in all four regions. Yet for Latin America, the region furthest along in the demographic transition, the decline in birth rates was more substantial; and the rise in rates of natural increase rather minor. The result was that by 1975, the regional differentials in rates of natural increase were narrow (from 25 1/2 to 29 1/2)--the rates being at relatively high levels in all four regions.

But the most interesting part of Table 4 is the indication that for three of the four regions, exluding Latin America, the next decade, to the mid-1980s, will show again a greater declines in the death rates than in the birth rates--with consequent further rises, even though minor, in the rates of natural increase. It is only in the period after the mid-1980s, that the birth rates are expected to decline substantially enough to exceed the still expected further declines in the death rates. Even so, one region--Subsaharan Africa-- is, according to the present projections, to show rising rates of natural increase practically to the end of the century.

Further subdivisions within the regions would reveal even further differences among various groups of the LDCs in the levels of their vital rates; while further distinction of narrower time periods would reveal more clearly differences in past and projected changes in these basic demographic trends. Thus, the differences among the presently distinguished four regions with respect to the timing in the demographic transition--from Latin America as the most advanced to Subsaharan Africa as the least--would be refined further; and so would the difference in timing in reaching the peak rate of natural increase, and the peaks and troughs in the underlying birth and death rates. But the distinctions in Table 4 are sufficient to indicate

both the similarities and the major differences in the movements of the death rates, in their relation to the levels and changes in the birth rates; and to remind us of the diversity of the demographic, and implicitly economic and institutional patterns, among the major groups within the LDC universe. The recognition of this diversity is particularly important, as we shift now to an exploration of the possible implications of these movements in death rates, in their relation to those in birth rates, for the internal economic distributions in the countries affected.

2. Some Implications

What were the likely effects of the recent population trends in the LDCs, summarized in the preceding section? In attempting to formulate some speculative but plausible answers to this question, it seemed best to start with (a) the effects of the rapid and striking declines in the death rates; and then turn to (b) the possible reasons for the lag in the declines of the birth rates. The separation between the two trends may seem artificial; and yet it will be argued below that the choices with respect to the downward movement of death rates were more limited than those with respect to the adaptive movement of birth rates. If only for this reason, one is warranted in considering the two sets of trends separately, before attempting to combine their possible effects.

(a) Declines in Death Rates

In dealing with the effects of the recent major declines in mortality in the LDCs, we may ask first what kind of demographic patterns prevailed in these countries before, when high death and birth rates yielded low rates of natural increase. Were there substantial within-country differences among the various economic and social groups, in demographic structure and

in the rates of natural increase?

No adequate direct evidence to answer this question is available to me, although a long search in the literature and greater familiarity with the sources might have provided it. But some plausible conjectures can be suggested. First, in these pre-1920 decades, as Table 1 indicated, the DCs were characterized by markedly lower death rates than the LDCs, so that the rate of natural increase in the former was substantially higher--despite the fact that their birth rates were substantially lower. This suggests that, with death rates in the LDCs at these high levels, even a moderate proportional lowering of the death rate could allow for a moderate decrease in the birth rate and still result in a substantial rise in the rate of natural increase. With CDR at say 40 and a CBR at 45, a drop in the former to 36 and in the latter to 42, would mean a rise in the rate of natural increase to 6 per 1,000--by a full fifth. One may reasonably assume that also within the LDC country or region, there could have been differences among economic and social groups, where greater wealth and easier access to means of subsistence could have resulted in appreciably lower death rates--and even if these led to somewhat lower fertility, the more favored economic of social groups might have attained a higher rate of natural increase--just as the DCs did in the comparison with the LDCs. This would particularly likely to be the case, so long as higher economic and social status were not connected with greater health risks in urban conditions (if urban living was a pre-requisite of higher income). But in the countries and times of which we are speaking, urban populations constituted a minor fraction of total population.[9]

The implication is that in the earlier, pre-1920 decades of high levels of both mortality and fertility, differences within the LDCs is

economic and social status may have been associated with reductions in mortality that were substantial, and larger than the likely restraints on fertility (if any)--thus yielding a higher rate of natural increase among the upper social and economic groups than among the lower. If this implication is valid, the resulting contrast with the conditions in times and countries in which the over-all level of death rates has been reduced sufficiently so that large relative mortality differentials could not convert even minor birth-rate excesses into equally or shortage of the rates of natural increase, is of major analytical importance.

Unfortunately, I can find only illustrative evidence, relating primarily to differentials in death rates in one or two less developed countries by economic or social status (directly given, or associated with some ethnic group distinctions); as well as separate evidence on birth rates by social status or ethnic grouping--but not the two bodies of evidence together. Thus to cite an example for India--the expectation of life for Parsis was (combined with equal weight for men and women) at birth, in 1931, as high as 53 years--compared with 32 years for total population; and the difference is "attributed in large measure measure to the relatively advantageous position of the Parsis."[10] If we apply crude conversion ratios to expectation of life at birth to derive crude death rates as used by Kingsley Davis, i.e. setting the latter to 1,000 divided by expectation of life)[11] the corresponding CDRs are 19 per 1,000 for the Parsis (a small group in the large total) compared with over 31 per 1,000 for total population--a difference that may or may not have been compensated fully by the difference in crude birth rates. Similar evidence of substantial differences in death rates appear in the summary of a sample survey of rural families in Punjab in

1931.[12] One may note that in the 1973 edition of United Nations, The Determinants.. the relevant section on mortality differentials in less developed countries (par. 132, p. 139) begins with a statement that information on these "differentials by occupation, income, and education is...sparse" and quotes but a few illustrations, mostly for the late 1950s or early 1960s.

A related illustration of interest can be derived from the vital rates for the United States, when the distinction is made between the white population and the non-white (the latter predominantly Negro). For 1905-1910 (the earliest period for which the comparison is given) the gross reproduction rate was shown at 1,740 for the white population and 2,240 for the nonwhite--an excess of the latter of some 30 percent; but the net reproduction rate, i.e. the one that takes account of mortality, was 1,339 for the white population and 1,329, somewhat lower, for the nonwhite population. This is an illustration of greater mortality in the economically and socially disadvantaged group more than offsetting a much higher fertility; and it is shown for a period when crude death rates averaged (for 1900-04) 16 per thousand for the white population and about 26 per thousand for the nonwhite.[13] It is plausible to assume that further back in time, when the level of death rates was appreciably higher, their excess may have produced an even greater differential in rate of natural increase in favor of the white population. By contrast, in the latter period, when death rates declined, for both white and nonwhite population, the net reproduction rate of the nonwhite population began to exceed that of the white by a large margin. Thus, by 1957 (the peak year in the US reproduction rates in recent times) the gross rate of the nonwhite population, at 2,371, exceeded that of the white at 1,764, by almost 40 percent; the net rates were 2,206 and 1,701 respectively, an excess of almost 30 percent.

Finally, one should note briefly the data on demography of peasant communities.[14] They deal largely with fertility, strongly suggesting, but with some exceptions, that fertility is higher among the richer (in terms of land) peasants than among the poorer; with mortality, at least in the children's ages, also being distinctly lower among the rich. The result then is a positive association within the peasantry between higher economic position and the rate of natural increase. But the results are qualified by sparsity of coverage, particularly for LDCs in the pre-modern periods of high mortality; the limitation of the data largely to fertility; the absence of data on per capita income of the peasant families classified by size over the life cycle; and the difficulty of assigning weights to the peasant population (distinctly smaller than the rural) within the total. A further exploration of the field, not feasible here, may yield significant findings.

If it be assumed that the rate of natural increase within the LDCs, prior to the recent sharp decline in death rates, was greater among the upper economic and social groups, the situation would have been in sharp contrast to that in the DCs for a number of decades and that in the LDCs once over-all death rate levels have been reduced substantially. The more familiar finding is that the birth rates and the rates of natural increase have been greater among the lower income groups--associated with the greater lag in the declines of birth rates among the former, in conditions in which a generally lower level of death rates reduced the weight of the death variable in offsetting births. This also meant that in the earlier times in the LDCs, the number of surviving children per family--once it reached a decade or more beyond the marriage date--was greater among the upper economic and social groups than among the lower, with the necessary

qualification concerning the urban death rate excess over the rural. Since the number of surviving children in turn is a major factor in determining the size of the family (the other being the degree of "jointness"), it is possible that the average size of the family was larger among the upper than among the lower economic and social groups; and that the average income of this larger family, even on a per capita basis, was significantly greater than that of the smaller-size family among the lower economic and social groups. Such positive association between the size of family and per capita income is not found in recent cross-section studies, which are naturally limited either to DCs or to LDCs with death rates already substantially reduced by recent advances in health technology. On the contrary, the negative association between size of family or household and its per capita income is a common finding; and while qualified by changes in income levels over the life cycle, still remained a major result in the analysis in the recent paper cited in footnote 1 (see Section III, pp. 23-48, on size of family or household effects).

But more important here is the implication that this situation of higher death rates and lower rates of natural increase among the lower economic and social groups meant a serious aggravation of already existing inequalities, in that shorter life spans, greater morbidity, and fewer children surviving to productive ages, were both cause and effect of lower economic returns over the family's productive lifespan. This association of lower economic position with higher rates of death and morbidity persisted, of course, beyond the transition in the population patterns from pre-modern to modern times; and are still found in the DCs in recent decades. But the effects of this association must have been far greater when death and morbidity rates were so high; and when substantial reductions

in them could be attained by more food, better clothing and shelter, and greater mobility for protection against epidemics or famines. Of course, we cannot guage now these death-rate and rate-of-natural-increase differentials; nor test their persistence in conditions of frequent short-term rises in death rates that might have swept over rich and poor alike. But one may assume that if there were these death and natural increase differentials in the pre-modern LDCs, they only served to aggravate long-term economic inequalities rather than to temper them.

In this connection, the exploratory illustrations of economic losses represented by the deaths of children and young adults in the Appendix to this paper is of interest. These explorations compare the losses of past inputs into children and young adults (the latter dying before their net contribution might have fully covered the inputs into their consumption in the past), in a less developed and developed country in the 1930s--relating these annual losses to the total annual product of each of the two countries. The results of the comparison, in their indication of relative losses involved in such deaths being over five times as great in the less developed than in the developed country, are only suggestive of what might be found in a comparison of similar losses from deaths for the richer (lower mortality) and poorer (higher mortality) groups <u>within</u> a pre-modern LDC. Clearly, the burden of such losses was proportionally much greater among the lower income groups, representing a greater relative drain on their long-term economic capacity and resources.

The purpose of the comments above is to provide a tentative base for evaluating the effects of the striking declines in death rates that we find in the tables in the first section. Given their magnitude and the character of the major causal factors that were involved. it is

reasonable to infer that these reductions in death rates were widespread; that their absolute magnitude was greater among those groups in the population for whom the initial levels were higher; and that consequently their effects on the rates of natural increase were far greater for those groups in the population for whom these rates were initially lower, viz. the larger groups at the lower economic and social levels. If the death rates for the upper and lower groups could differ by as much as 10 points (e.g. 30 to 40), it could be expected that a major step forward in health care and medical technology applicable without a major input of scarce resources and without requiring major changes in patterns of life, would affect the higher death rates absolutely more than it would the lower death rates levels already reduced by more favorable economic conditions in the past. And one could also argue that the benefit to those who have sustained the losses in the past caused by higher death rates would also be greater. The immediate implication, subject to a major qualification to be noted below, is that the differential reduction in death rates plausibly assumed above, the resulting convergence of internal death rates among various economic and social groups, meant the reduction of an important aspect of persisting inequality that loomed large in the pre-modern LDC societies.

Before we consider the possible qualification on the equalizing effects of the internal differentials in reduction of death rates in the LDCs, once the major declines began, one should stress two aspects of the trends under discussion. The first, already noted, is that there was little choice possible, or wanted, in incurring these declines. If they came, largely as effects of developments in the DCs brought into the LDCs as it were from the outside, relieving sickness and death without incurring perceptible economic and social costs, there was no incentive for resisting

the much desired opportunity for longer and healthier life. In that sense, the situation was quite different from the choices relating to birth rates, the reduction of which involved a variety of alternatives within limits that could spell substantial differences in population growth rates, for countries or for groups within them. Second, and more important, once contacts with the developed parts of the world were increasingly numerous, it became obvious that the reduction in death rates (and associated reduction in rates of morbidity) was a necessary if not sufficient requirement for a healthier, long-lived, populations--with the possibility of longer investment in the training and education of the younger generation preserved from demographic calamities, with the chances of developing a forward spirit in a population justifiably believing in control by man over his destiny, and a family structure in which smaller size and fewer children would make possible a better adjustment to widening economic and social opportunities. Rejecting the contacts that reduced the death rates would thus mean rejecting also the possibility of shifting to a modern demographic pattern and modernization of society that could also mean better use of the potentials of economic growth.[14]

The conclusion is that the reduction of the death rates from their initial high levels in the LDCs in the 1920s was an indispensable condition for eventual modernization and participation in modern economic growth--while the rapidity and magnitudes of the declines were a unavoidable (were anybody willing to avoid it) effects of the new technology in situations of an accumulated backlog of high mortality and high morbidity problems. Whatever the immediate, or shorter term other consequences of these trends, particularly those when the failure of birth rates to decline resulted in a rapid acceleration of the rates of natural increase, in the longer run the

major declines in death rates were necessary as a pre-condition of the declines in birth rates and of other adjustments to the modern demographic patterns of population growth.

The major qualification alluded to above is, of course, the consequence of lag of the decline in birth rates--in conditions where the basic innovation introduced by the reduction in death rates occurred without being accompanied by sufficient changes in other aspects of social and material technology. In such conditions, and provided there was, as there was likely to be with stagnant social structure and production technology, scarcity of the traditional resources (whether they be land or reproducible capital), a rapid acceleration of rates of natural increase among the groups hitherto below the upper economic and social levels may have meant suddenly increased pressures of augmented labor supplies on scarce complementary resources. Whether under these conditions a longer and healthier working life of the members of a family compensated, over the lifecycle, for the greater pressure of labor on resources, is a question that does not admit of an easy answer; and the answer would vary among various groups of LDCs, depending upon the initial resource endowments and the degree to which further advances in traditional technology were possible with augmented labor. Here the added knowledge concerning the demographic and economic structures of LDCs prior to the recent declines in death rates would be required to provide even tentative answers. But one cannot exclude the possibility that in some cases the longer productive lifespan and greater increase of the lower economic and social groups may still have resulted in some widening of internal income inequality, because of the advantage taken by upper groups of the greater pressure of labor on land or on other capital; while in other cases the inequality-reducing internal convergence of rates of mortality and

morbidity among the several economic groups might have resulted in reduction of internal income inequality--even if the crude brith rates continued at high levels and failed to respond for some time to the declines in death rates.

On this uncertain conclusion, we end our discussion of the effects of declines in mortality in the LDCs. One should emphasize to the end, both the indispensable, and in the longer run beneficial, effects of the declines in the death rates--regardless of whether their immediate and direct effect was to widen or to narrow internal income inequalities. This emphasis might have been superfluous, except for the tendency in much recent discussion of the problems created by rapid population growth to neglect the source of the latter in the declines in mortality and morbidity--and thus to understate, by omission their vitally important and beneficial long-term effects.[16]

(b) Lags in the Decline of Birth Rates

The long lag in fertility decline behind the downtrend in mortality is illustrated in Professor Lindert's paper for this Conference, on "Child Costs and Economic Development"; and is strongly suggested for the LDCs in the initial section of this paper, with its emphasis on the dominance of declines in mortality in contribution to a rising rate of natural increase in the face of constant or only slightly dropping birth rates. The present section deals with a few aspects of the response of birth rates to the major declines in death rates in the LDCs.

Even though the would-be parental pair is the immediate decision unit in this response, one must allow for the wider, blood-related groups (an extended family, a tribe, an ethnic group, a caste) that may set the norms for the would-be parents. In addition, there are the large non-blood

collectives, particularly the government, which may react to declining death rates and accelerating population growth in a variety of ways, all of which involve modifications of conditions under which the family unit would make decisions concerning more or fewer children--whether the steps are limited to exhortation and provision of cheaper methods of birth control, or extend to drastic policy measures affecting the costs of more children. On the other hand, the effects of declining deaths include more than just increase in numbers of surviving children. The underlying innovation in health and medical technology may reduce involuntary sterility formerly associated with widely prevalent debilitating diseases; it may raise intra-marital fertility by prolonging the duration of marriage (within the childbearing span of the wife) through the reduction of mortality (particularly male) in the procreative ages--just as it may eventually, through the reduction of uncontrollable and unpredictable diseases, introduce changes in the outlook of would-be parents on the future and the role in it of the next generation. Given the diversity of possible sources of decisions in response to declining death rates, the variety of direct and indirect effects of the latter on the birth rate response, and finally the inadequate knowledge at hand here of the parameters of demographic processes and of economic and institutional patterns in various LDC regions, we can attempt only a limited probing.

This is true even if we eliminate from consideration the Communist societies, in which the power of the single-party, ideologically-motivated, state government is such that its responses to declining death rates and accelerating population growth may dominate whatever free responses could have originated within the population masses of the country. Such domination is suggested by the power of intensive propaganda, control over location and

migration of the population, disposition over the basic consumer goods, particularly housing, needed for a growing population, and the like. I would find it difficult, for lack of adequate knowledge of societies so organized, to formulate a rational basis for evaluating the planned response that the decision-centers at the governmental levels of these countries would make to declining death rates and rising rates of natural increase. The same criterion might also lead to exclusion of non-Communist, dictatorially organized LDCs, in which a similar domination of the state over the free responses of the population might be expected; but there are no clear relevant measures at hand for drawing the line. The purpose of the comment is to call attention to the possible policy interventions of non-familial, non-blood related groups, particularly those endowed with internal sovereignty. They may be important in both dictatorially and domocratically organized societies; but their weight seems more dominant in the former--sufficiently so to warrant limiting further discussion by concentrating on the societies with relative freedom of decision by families and related blood groups.

The importance of the wider, blood-related groups that encompass the individual families is clearly great in LDCs, whether they be the tribal groupings in much of Africa, the racial-ethnic divisions within many Latin American countries, or in Asian countries where limited inter-marriage among group (say among castes in India) is still the norm. In conditions of relative weakness- and instability, of the country's collective institutions, particularly of the state, such wider blood-related groups serve an important function in providing long-term security to individual families in conditions of group competition within the country. The response of a family to declining death rates and more surviving children would, with reference to the wider-group norms, differ from that of an

individual family within a stable political framework and relying securely on the protection and stability of a strong government representing the interests of the community and of all its parts. An adequate analysis would require taking specific account of these various blood-related subgroups within the populations of the several LDC regions in the process of their reaction to declines in death rates. But for obvious reasons, our discussion can take only general cognizance of these sources of influence on the birth-rate decisions of would-be parents.

We can now face a limited question. Assume that the individual families, the pairs of would-be parents, either experience or observe a perceptible reduction in death rates, through the reduction of both infant and childhood mortality and declines in deaths at adult ages. Under what conditions would we expect a relatively prompt and full response of birth rates such as would prevent the rate of natural increase from rising substantially and over a relatively long period? These conditions would presumably bear on (i) the firmness of judgment with respect to continuity (irreversibility) of the observed declines in mortality; (ii) the relation of the resulting numbers of surviving children to the desired numbers; and (iii) the identity of the population group in a position to realize an effective birth rate response, and the limits of their possible perception of mortality declines.[17]

(i) Given the emergence of a marked downturn in death rates as a novel phenomenon for populations and countries that have experienced for centuries a much higher average level of mortality, and most important, with instability characterized by sharp short-term declines and equally short-term larger rises, a fairly long period of observation and experience at lower and stable death rates would be required before a response could be expected. This is particularly true at the later stages of the woman's

childbearing span where a decision to forego another child, in reliance on the persistence of low death rates for children, may be beyond repair if the expectation proves false. How long a period of waiting to test the persistence of the mortality trend one should reasonably assume, would have to be estimated from an analytical case in which all other factors affecting the decision (except the decline in mortality itself) have been removed (i.e. held constant)--not an easy task. A span of well over a decade seems a minimum, and one could perhaps argue that, ruling out downward revisions in numbers of desired surviving children, a whole generation might have to pass before the next parental generation could react significantly. Yet, given the declines in crude death rates averaging between 4 and 5 points per 1,000 per decade over the last half century (in the LDCs from the mid-1920s to the mid-1970s), a lag of only one decade would mean a substantial addition to the rate of natural increase--which would continue so long as the death rates continue to decline, even though persistence of the latter would, as time goes on, raise confidence and reduce the lag.

The judgment of confidence in the continuity and irreversibility of a new social trend is hardly a factor susceptible of tests for either ex-ante or post-facto validity; and one hesitates to assign a large weight to it. Yet complete neglect of it implies a neglect of a possibly major problem of the channels by which effective perception of, and response to, of new social processes are attained within the traditional, and later transitional, framework of LDCs. It may well be that a long delay in response to new trends is a rational reaction, due partly to limitation of information, partly to lack of resources for taking chances on uncertain trends and for overcoming the fear of the unknown.

(ii) The conjecture under (i) becomes less relevant if we can assume that over a long initial period of the decline in mortality in the LDCs, the desired number of surviving children remains higher than, or in the neighborhood of, the actual number (as perceived by the family). Given targets or norms, whether individually elaborated or more realistically set as norms in the form of socially approved patterns, whether hard, or more realistically, with soft margins, it is not difficult to see that beginning at the pre-modern levels of death and birth rates, there might be a long period of sustained mortality declines--and yet the resulting number of surviving children would remain short of, or close to the desired target, thus providing no incentive for a response-decline in birth rates.

To begin with, the declines in mortality and morbidity permit those groups in the population that formerly could not reach their fertility targets, either because of involuntary sterility, or because of institutional constraints on remarriage of widows, or other similar consequences of past mortality and morbidity, now to start approximating them. Far more important, quantitatively, is the condition of the large economic and social groups below the narrowly defined top. Given the rather low rate of natural increase of LDCs, just prior to the initiation of the recent downtrends in mortality (of about 0.5 percent in the 1920s), it is reasonable to suggest that for the majority of the population the numbers of surviving children was below the desired. This suggestion is strengthened if we assume the earlier conjecture (discussed in Section 2a above), that at the top economic and social levels in the pre-modern LDCs death rates and rates of natural increase were substantially lower and greater respectively than at the lower levels. For this would mean a long-persisting pattern of association of a much larger number of surviving children with the higher economic

and social status, which would most likely be carried over into the initial decades of the declines of death rates in the LDCs--unless there are prompt and major changes in the desired numbers, a possibility that largely depends on underlying major changes in the economy and institutions of the country, a shift at high gear into modernization that is likely to be the exception rather than a rule.

If so, a substantial phase of the long-term decline in death rates in the LDCs would also be a phase of catching up with formerly unavailable potentials of desired number of surviving children. How long this catching-up phase, representing lack of incentive for a response of birth rates, would be is a matter for conjecture. It might differ from one group of LDCs to another; and would certainly differ in its historical chronology with disparities in the historical dates of the initiation of the major mortality declines among the different groups of LDCs. But if the natural-increase differences in pre-modern LDCs were as large as the scattered data on mortality (and some on fertility, particularly for the peasant communities) suggest, being at a minimum 10 points per 1,000, it might take at least two decades for the catching-up phase to be completed; nor should the possibility of a longer period be ruled out. If so, this phase would largely overlap with any lag due to lack of confidence in the persistence and irreversibility of the mortaility trends, discussed under (i) above.

(iii) The perception of a trend such as that in the death rates in the LDCs in recent decades may be limited to that of major <u>absolute</u> declines--which were concentrated in the early childhood ages, at one end, and in the advanced age brackets beyond the early 50s, at the other. Following the comment made above, we may ask how the population groups who are in a position to

affect birth rates, either because they are in the childbearing ages, or because they exercise influence on the latter, perceive the demographic trends. In the LDCs, in the transition period, and outside of the limited upper circles of government, this is hardly done by scrutinizing aggregative statistics or observing graphs. But the answer as to how families and the blood-related groups to which they may belong attain their perception of major demographic trends would have to be provided out of greater familiarity with the LDC societies and the mechanism of ascertaining and diffusing major social data than is possessed here.

One part of the answer is to suggest that reduction in the mortality of children, sizable only in the very early ages (below 5), are surely observed by those families in procreative phases of their life cycle that enjoy the benefits of such decreased mortality. And it may be legitimately argued that the knowledge of, and reaction to, this part of the downtrend in mortality could be expected to be more direct and potentially affective (other conditions being favorable) than the knowledge of, and reaction to, the decline in mortality at the advanced adult ages. It would also follow that if the knowledge of trends is extrapolated into the future, in the process of formulating birth decisions, the reduction in early childhood mortality would be far more likely to form the basis for such an extrapolation than the changes at the advanced adult ages--which would relate to the role of children four or five decades after their birth. To be sure, neglecting these latter, as we do in the statistical illustration that follows, means neglecting the insurance motive of assuring survival of children to ages when they could support the old parents. But granted this limitation, it is of interest to explore what an instantaneous and complete response to declines in mortality at the early childhood ages would mean for the

movements of the rates of natural increase.

The estimates of what may be designated the offset response of birth rates to declines in death rates, presented in Table 5, are based on two assumptions: that the response is to reduction in death rates at ages under 5; that the response is prompt and full, allowing for no lag in the process. Both assumptions are unrealistic, the second far more so than the first. But the result is an extreme version of a full major response of birth rates; and it is of interest, in deriving it, to compare it with the actual movement of the birth rates and the trend in the rates of natural increase.

Given these assumptions, we need measures of the decline not only in crude death rates for total population, but also of that in the death rates of the population 0-4. Panel A of Table 5 summarizes the results of utilizing the rich data in the UN Working Paper repeatedly used here, which shows for individual countries and for regions not only crude birth and death rates and total population at quinquennial intervals beginning with 1950, but also the proportions, in total population, of the 0-4 group (as well as of other age groups, 5-14, etc). On the reasonable premise that all these domographic parameters are consistent with each other, it is possible to derive, by comparing the cumulated crude birth rates over quinquennium related to total population at mid-point of the period with the surviving 0-4 population at the end of the quinquennium (related to the population at the end of the quinquennium) what the proportional attrition (per 1,000) was. If the population is closed, with no emigration or immigration, this attrition rate is identical with the crude death rate for the 0-4 group. Given the size of the regions that we deal with, and the demonstrated closeness between the growth rates in total population and

Table 5 Estimated Offset Response of Birth Rates to Declines in Death Rates of Children 0-4, 1950-55 to 1970-75, The Four LDC Regions of Table 4

Panel A. The Relevant Demographic Parameters
(per 1,000 of underlying population)

		East and M.S. Asia (1)	Middle East (2)	Subsah. Africa (3)	Latin America (4)	All Four (5)
	Data for 1950-55					
1.	Proportion of 0-4 to total pop. 1950	153	164	170	169	160
2.	Ditto, 1955	162	169	180	178	168
3.	CRNI, 1950-55	18.9	24.7	20.1	28.5	21.1
4.	0-4 population in 1955 as proportion of total in 1950 (per 1,000)	178.3	190.9	198.8	204.9	186.5
5.	CBR, 1950-55	44.1	47.1	48.1	43.7	45.0
6.	CBR in line 5, shifted to the base of 1950	46.26	50.06	51.18	46.88	47.41
7.	Cumulative births, 1950-55, as proportion of 1950 population	247.8	276.6	283.5	257.5	260.5
8.	Attrition (death rate) per 1,000 of 0-4 population in 1950-5, per year (from lines 4 and 7)	63.0	71.4	68.0	42.5	64.1
9.	CDR, total population, 1950-55	25.2	22.4	28.6	15.2	23.9
	Data for 1970-75					
10.	Prop. 0-4 to total population, 1970	169	173	178	171	171
11.	Ditto, 1975	167	171	181	167	170
12.	CRNI, 1970-75	25.4	28.3	25.8	29.7	26.4
13.	0-4 pop. in 1975 as prop. of total in 1970	190.3	196.8	205.6	193.3	193.7

		East and M.S.Asia (1)	Middle East (2)	Subsah. Africa (3)	Latin America (4)	All Four (5)
14.	CBR, 1970-75	41.9	43.1	47.6	38.9	42.4
15.	CBR, to the base of 1970 population	44.51	46.19	50.73	41.85	45.25
16.	Cumulative births, 1970-5 as prop. of 1970 populat.	240.8	252.9	280.7	230.0	247.7
17.	Attrition (death rate) of popul. 0-4, in 1970-5	45.4	48.1	59.8	33.3	47.4
18.	CDR, 1970-75	16.5	14.8	21.8	9.2	16.0

B. Derivation of Offset-Response in Birth Rates to Decline in Death Rates of 0-4 Population
(all entries per 1,000 of relevant population)

19.	Decline in death rates of 0-4 population from 1950-5 to 1970-5	17.6	23.3	8.2	9.2	16.7
20.	Proportion of 0-4 population to total at initial date	0.17	0.17	0.18	0.18	0.17
21.	Decline in death rates of 0-4 population related to total pop. (line 19x line 20)= full-offset response	3.0	4.0	1.5-	1.7	2.8
22.	Observed decline in CBR	2.2	4.0	1.1	4.8	2.6
23.	Observed change in CRNI	+6.5	+3.6	+5.7	+1.2	+5.3
24.	Derived change in CRNI with full offset-response	+5.7	+3.6	+5.3	+4.3	+5.1

Notes

All the underlying data are from the UN working paper, cited and used in connection with Tables 2 and 3.

Panel A--lines 4 and 13: The estimates are the proportions in lines 2 and 11, raised by the cumulative growth of population (cumulative natural increase) over the quinquennium, using the entries in lines 3 and 12 respectively.

Panel A--lines 6 and 15: The estimates use the rise of the base (total) population, but over half rather than the full quinquennium (as it was used for lines 4 and 13).

Panel A--lines 8 and 17: The entries in lines 4 and 7, and 13 and 16 respectively, were used first to derive attrition (deaths) as the difference between lines 7 and 4, and 13 and 6, related to the initial base (1950 and 1970 respectively) and representing the proportion over the quinquennium. Then the population was adjusted for a shift from the 1950 or 1970 base to the 1950-55 and 1970-75, using the entries for 0-4 population in lines 1 and 4, and 10 and 13 respectively. The adjusted proportions, now to the base of 1950-55 and 1970-75 respectively, were then converted into per year declines in death rates, related to total population.

Panel B--for the rationale see discussion in the text. Line 19 is the difference between lines 8 and 17 of Panel A. Line 20 is based on the shares a shown in lines 1 and 4, and 10 and 13 of Panel A. Line 22 was derived from the observed CBRs in lines 3 and 14 of Panel A. Line 23 was derived from the observed CRNIs in lines 3 and 12 of Panel A. Line 24 equals line 23 reduced by the excess of line 21 over line 22 (or raised by the shortage of line 21 relative to line 22).

the rates of natural increase, it seemed justified to identify the attribution rates thus calculated with death rates relating to the 0-4 population. The estimates are clearly approximate, but the resulting orders of magnitude are plausible.[18]

With the results in Panel A, which show the declines in death rates of 0-4 population between 1950-55 and 1970-75, and the proportions of that population in the total at the start of each quinquennium, we can estimate what the offset-response of birth rates would be--on the assumption that birth rates would decline, without any lag, to offset fully the experienced reduction in childhood deaths (Panel B). It will be noted that the derived response was only somewhat larger than the actual decline in birth rates, in three of the four LDC regions--a rough agreement which, however, cannot be interpreted to mean that the observed drop in the birth rates did represent the assumed offset-response. It could well have been due to a substantial decline in birth rates of the top economic and social groups, only partly offset by the constancy or slight rise in birth rates among the lower economic groups. In Latin America, the observed decline in birth rates, of almost 5 points, greatly exceeded the derived offset of 1.7 points; and this finding is plausible, considering the much longer period over which declines in mortality occurred in Latin America, and the greater movement toward the demographic transition that began to affect the birth rates.

But the major aspect of the finding in Panel B is that even if we assume full and instantaneous response to declines in childhood mortality, such a response will not be sufficient to prevent a major rise in the rate of natural increase. As line 24 shows, the derived rate of natural increase shown a substantial rise over the two decade span in all of the four LDC regions.

The results are as one would have expected. If the birth rates respond to declines in childhood mortality alone, the rates of natural increase will be raised by the declines in mortality in ages above those of childhood--and largely by reduced mortality in the advanced adult ages. If we were to allow for effects of deaths also of children 5 years and age and over, there would have been a somewhat larger, but not much larger offset response. If, as partial data indicate, total deaths of children under 15 were only about 60 percent of total deaths, while the share of the 0-14 group ranged about 42 percent of total population, the implicitly more moderate decline of death rates for 5-14 than for the 0-4 populations, might, if taken into account, raise the estimated offset decline in line 21 by about a tenth, but not more than that.

The major conclusion is that if it is largely childhood deaths that affect the birth rate response, then even the full and prompt response (neither likely) would still be insufficient to prevent a substantial rise in the rates of natural increase. Under the assumed conditions, the latter will cease rising only when the death rates above the childhood ages cease declining. Or to put the conclusion in its converse form. While death rates are declining, sharply and with the usual concentration in early and advanced ages, the possibility of avoiding large rises in the rates of natural increase would lie not so much in a response of birth rates to childhood mortality--a most likely response, yet even so not promptly or fully--but in changing conditions that would affect the total number of desired surviving children. Such changes in conditions are not automatically provided by declines in death rates and by those factors behind them that appeared to have been operative in the case of LDCs in recent decades. On the contrary, the conjectures under (ii) suggest a long

initial period in the decline of death rates when the desired number of surviving children may continue to remain above that yielded by declining childhood mortality levels.

But what are the implications of our discussion of the responses of birth rates to the declines in death rates? At the end of the preceding sub-section, which dealt with the declines in death rates, we came to a rather uncertain conclusion as to the effects of the greater declines in death rates among the lower economic and social groups than among the upper groups, for whom death rates were already appreciably lower because of better nutrition, housing, etc. We argued that prolongation of life, and closer convergence of death rates among various economic and social groups, removed one major aspect of long-term inequality. This reduction could be offset by greater pressure of higher rates of population growth on scarce traditional resources, unless such pressure was relieved by economic and social innovations associated with modern economic growth. We add now the conclusion that even with full and prompt offset response of birth rates to declines in death rates of 0-4 population, there will be acceleration of rates of natural increase; and such acceleration will be greater among those groups for whom the declines in death rates were the greater, i.e. among the lower economic and social strata. And this should mean that instead of a positive association between economic and social levels and group rates of natural increase, the trends discussed will produce an inverse association between economic and social levels and the rates of natural increase. But this does not imply a necessary widening of per capita income inequalities if we deal with long-term levels of life cycle income--which will now be sustained by the longer span over which life and productivity can now be maintained among the lower income groups, as they could not be so maintained in the pre-transition past. The conclusion is

still uncertain; but one may argue that both the trends in the birth rates and the trends in income inequality depend heavily on economic and social transformation that relieve the pressure of growing population on the scarcity of traditional resources, and that induce downtrends in the birth rates over and beyond those derivable as offset responses to declines in childhood mortality.

This latter argument could be developed further by indicating that the technological innovations associated with modern economic growth, which are the main source of the economic advance, depend heavily upon new knowledge; and that they and the associated social innovations require a much greater emphasis on higher levels of education and training of the younger generation that would be carrying the innovational process further. Once this connection between investment in the younger generation and further economic and social advance is established, the shift toward greater investment by the older generation in the young (away from the earlier pattern of the younger generation contributing to their elders within the wider family) will take place,[19] and there will be a resulting change in the number of desired surviving children, with its major effects on the birth rates. The important link in this argument is between the sources of economic advance and the needed contribution of the younger generation if these sources are to be maintained--a contribution that demands the greater investment in education and training. And it is in this connection that a decline in death rates of the type that occurred in LDCs in recent decades looms as an indispensable condition. How the eventually resulting declines in birth rates develop, whether they begin at the top and how rapidly they spread through the wider groups in the population, are questions and possibilities of obvious bearing upon income distribution while the

transition process is taking place. But these arguments take us well beyond the immediate impacts of the death rate trends in the LDCs, the major so far observed movement. And it would require more analysis of the differential death rate movements and of the related movements in birth rates to permit adequate discussion of the wider inter-connections just suggested.

Appendix. Economic Losses Represented by Deaths: Exploratory Illustrations

The appendix is devoted to illustrative exploration of economic losses represented by deaths, with special attention to the differences between the high death rates of the LDCs and the much lower mortality of the DCs. The discussion is directly relevant to the effects of the major declines of the death rates in the LDCs, emphasized in the text. But in view of the complexity, and the difficulty of arriving at defensible approximations, even of the order of magnitudes, it seemed best to shift the exploration to a separate appendix.

The discussion is limited to direct economic costs or losses. No attempt is, or can be, made to attach magnitudes to the psychological and emotional effects of death upon members of the family. Nor can we deal with indirect negative effects, e.g., the greater unpredictability and variability over time of mortality in condition of limited control over disease.

An even more important exclusion is the neglect of the association between high death rates and high levels of morbidity--i.e., incidence of disease, apart from higher mortality. Given this association, the level of death rates is clearly suggestive of the level of morbidity; and higher incidence of disease either in childhood or in adult ages would presumably have negative effects on productivity, either because of lasting debilitating effects of an earlier disease (even if incurred in childhood) or because of direct impact and consequences of such diseases affecting adults in working ages. Any attempt to measure the losses so involved in LDCs, in comparison with those in the DCs, would run into the difficulty of separating the effects of health conditions from those

of nutrition and other components of the standard of living. But it is reasonable to assume that these losses from higher morbidity associated with higher death rates in the LDCs are significantly greater than similar relative losses in the DCs. If so, the comparison of economic losses suggested by deaths in the discussion that follows underestimates the excess relative loss in the less developed countries.

In dealing here with direct economic losses debited to deaths, we use for illustration the relevant demographic data for 1937 for two countries, Egypt and the Netherlands (see App. Table, Panel A). With further search, we probably could have found the data for a wider contrast with respect to death rates, crude and age-specific. But the contrast observed in Panel A in the crude death rates, between 27.3 per 1,000 for Egypt and less than 9 per 1,000 for the Netherlands, is sufficiently wide for our purposes. The purpose here is to suggest the wider ramifications of the comparison with respect to the economic losses involved--rather than attempt a full estimate of the orders of magnitude.

A glance at the age specific death rates in columns 3 and 6 of Panel A reveals that these rates are higher in Egypt than in the Netherlands for <u>each</u> age-class distinguished; that the ratios of the age-specific death rates in Egypt to those in Netherlands tend to be higher in the early ages than at the later, the decline in these ratios interrupted only by the extremely high ratio for the 1-4 years old age class; and that the greater share of the younger age groups, particularly below 15, in the total population, in Egypt than in the Netherlands, tends to accentuate the disparity in the crude death rates. Whatever losses are represented by deaths are bound to be much greater in the high death rate country like Egypt, at least in relation to its total economic magnitude,

than in a low death-rate country like the Netherlands. It also follows that if the recent major declines in the LDCs proceeded on the path suggested in the text, with larger declines among the lower economic and social groups with initially much higher mortality than among the more favored, upper economic groups, the resulting convergence within the country among group death-rates would mean also convergence in the relative burden of losses represented by deaths. But how do we estimate, as a first approximation, the direct economic losses that deaths represent?

Two different approaches may be followed. In the first, the losses represented by deaths would be defined as inputs into past consumption of children and young adults offset by productive contributions that the deceased might have made. The question that is being answered is, then, what unoffset consumption inputs might have been avoided if the children and young adults whose death we are considering would never have been born. In the other approach, the losses represented by deaths are viewed as the projected net productive contribution of the deceased that could have been expected but for the irreversible loss. This is the lost opportunities, rather than the lost costs, approach; but both deal with only economic costs, opportunities, and returns, not with the psychic. We follow here the first approach, carried through more easily and dealing with historical facts and incurred burdens, rather than with extrapolated possibilities and lost future opportunities.[19]

Panel B-1, columns 1 and 3, reveals that total childhood deaths in a year account for 1.7 percent of total population in Egypt, but only 0.117 percent in the Netherlands(line 18)---a ratio of over 14 to 1. To estimate the input in these children to whose death we are trying to

Appendix Table 1

Economic Losses Implicit in Death Rates, An Illustrative Calculation, Egypt and The Netherlands, 1937

A. Distributions of Population and Deaths by Age Classes, and the Age-Specific Death Rates.

		Egypt			The Netherlands		
		% share pop.by age (1)	% share deaths by age (2)	ASDR per 1,000 (3)	% share pop. by age (4)	% share deaths by age (5)	ASDR per 1,000 (6)
1.	Below 1	3.1	26.5	234.4	2.2	8.6	34.3
2.	1-4	10.2	29.5	78.9	8.1	2.6	2.8
3.	5-9	14.0	3.9	7.6	9.8	1.2	1.1
4.	10-14	12.1	2.0	4.5	9.2	0.9	0.9
5.	0-14	39.4	61.9		29.3	13.3	
6.	15-24	15.4	3.2	5.6	17.8	3.1	1.5
7.	25-34	15.7	4.4	7.7	15.4	3.6	2.1
8.	35-44	13.1	4.9	10.1	13.0	4.8	3.2
9.	45-54	8.3	4.5	14.7	10.3	7.7	6.6
10.	55-64	4.5	4.1	24.8	7.5	14.4	16.9
11.	15-64	57.0	21.1		64.0	33.6	
12.	65 and over	3.6	17.0	127.2	6.7	53.1	69.6
13.	Total	100.0	100.0	27.27	100.0	100.0	8.78

B-1. Economic Losses from Childhood Mortality

	Egypt			The Netherlands		
	Deaths,% of Total Popula. (1)	Loss Multi-ple (2)	Loss, % of 100 CU (3)	Deaths, % of Total Popula. (4)	Loss Multi-ple (5)	Loss, % of 100 CU (6)
14. Below 1	0.7266	0.25	0.1817	0.0755	0.25	0.0189
15. 1-4	0.8048	1.50	1.2072	0.0227	1.50	0.0340
16. 5-9	0.1064	3.75	0.3990	0.0108	3.75	0.0405
17. 10-14	0.0545	6.25	0.3406	0.0083	6.25	0.0519
18. 0-14	1.6923		2.1205 (2.681)	0.1173		0.1453 (0.174)

Appendix Table 1 (continued)

B-2. Residual Economic Losses, Adult Mortality

	Egypt				The Netherlands			
	Deaths, % of Total Population	Assumed Output per Pers. (CU)	Resid. Cost Begin. of Age Class CU's	Resid. Loss, % of 100 CU	Deaths	Output	Resid. Cost	Resi Los
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age Class								
19. 15-24	0.0862	1.000	7.50	0.6465	0.0267	1.000	7.50	0.20(
20. 25-34	0.1209	1.322	7.50	0.7121	0.0327	1.224	7.50	0.20(
21. 35-44	0.1323	1.644	4.28	0.1402	0.0416	1.449	5.26	0.12
22. 45-54		1.644	-2.16			1.449	0.77	
23. Total				1.4988 (1.888)				0.531 (0.63(
24. Total, for Panels B-1, and B-2, % of total product				4.57				0.81

Notes

Panel A

The data used here are taken, or calculated, from United Nations, Demographic Yearbooks, 1949-1950, and 1951. New York, 1950 and 1951. The distribution of the population by age for Egypt is for late March 1937, and is from the 1949-50 Yearbook, Table 4, pp. 104 ff; that for the Netherlands is the average of the percentage shares for 1930 and 1945, from the same table. The small fraction of age-unknown is allocated proportionately. The distribution of deaths by age is from United Nations, Demographic Yearbook, 1951, New York 1951, Table 16, pp. 216 ff; and relates to the deaths in 1937 for both countries.

The age specific death rates in column 3 are derived by relating the absolute numbers of deaths to the relevant population; but the multiplication of the ratio of column 2 to column 1 by the crude death rate

Appendix Table 1 continued
Notes (continued)

(line 13, col. 3) yields identical results, except for errors of rounding. The age-specific death rates in col. 6 were derived by multiplying the ratio of col. 5 to col. 4, by the crude death rate in line 13, col. 6 (8.78).

Panel B-1, Cols 1 and 4

The entries were derived by multiplying the age-specific death rates (see Panel A, cols. 3 and 6), expressed as proper fractions, by the percentage share of the age-class in total population (see Panel A, col. 1 and 4).

Panel B-1, cols. 2 and 5

Entries calculated on three assumptions. (a) Consumption per child is 0.5 of that for the adult in working ages (15-64). (b) Total income of the country is the sum of all consumption units, the latter being 0.5 per child; 1.00 per adult in working ages; 0.75 per adult aged 65 and over. (c) The number of years within the lifespan of the children dying is 0.5, 3.0, 7.5, and 12.5 respectively for the successive age class under 15---representing linear interpolation and cumulation of the age-class limits. The entries in cols 2 and 5 are then the products of 0.5 by the number of years.

Panel B-1, cols. 3 and 6

The entries are the products of those in cols. 1-2, and 4-5---for lines 14-17; and direct sums in line 18.

The entries in parentheses in line 8, cols. 3 and 6, are the total loss related to the total number of consuming units. Based on the assumptions stated above, the latter total for Egypt is: (39.4%) (0.5) + (57.0%)(1.0) + (3.6%)(0.75) = 79.4; and for the Netherlands, using a similar equation---83.675. Division by these totals used as proper fractions (to 100) yields the percentages in the parentheses.

Appendix Table 1 continued

Notes (continued)

Panel B-2, cols. 1 and 5

These again are the products of the age specific death rates by the proportion of the age class in total population, both being taken from Panel A (see notes to Panel A, cols. 1 and 4).

Panel B-2, cols. 2 and 6

The life cycle pattern of product per person in the working ages (and also for age 65 and over) is based on the following assumptions. (a) The product per person in age 65 and over is 0.75 CU, just sufficient to cover consumption. It follows that the product per person for ages 15-64 must cover more than the per person CU, to compensate for the consumption of children under 15. The average excess in per person product in ages 15-64 is given by the ratio of all consumption units for people under 65 to the number of people in working ages (i.e. for Egypt, [(39.4 x 0.5) + (57.0 x 1.0)] divided by 57.0; for the Netherlands - [(29.3 x 0.5) + (64.0 x 1.0)] divided by 64.0. (b) It is assumed that in the age class 15-24 product per person just equals consumption, i.e., 1.0; that there is a peaking plateau in ages 35-44 and 45-54, per person product being equally high in the two age classes; and that in the intermediate age classes (25-34 and 55-64), the per person product is a simple average of the preceding and following class means. Given assumptions (a) and (b), it is possible to solve one-variable equation to find the value of the peak level (which proves to be 1.644 in Egypt and 1.449 in the Netherlands), and thus of all the lower class product per person.

Appendix Table 1 continued

Notes (continued)

Panel B-2, cols. 3 and 7

The initial value here is the product of 0.5 CU (consumption per person per year) by 15, the number of years elapsing to the beginning of the 15-24 age class. From then on the cumulated past costs are affected by the surplus of product over assumed consumption in the successive age classes of adults in working ages---the surplus being the difference between the enries in cols. 2 and 6, and 1.00.

Panel B-2, cols. 4 and 8

The entries are product of the entries in col. 1 and 4, by the average of those in cols. 3 and 7 (e.g., for line 20, it would be the average of 7.50 and 4.28, in col. 4; and of 7.50 and 5.26 in col. 8)---all of this for lines 19 through 22.

For entries in lines 23 and 24, whether the sums in top lines or in the parentheses, see notes to the relevant part of Panel B-1.

assign an economic weight, we are assuming that the annual consumption per child amounted to 0.5 of the consumption of an adult in the working ages; that the productive contribution of children was negligible and no offset to the input of past costs is to be entered; that with stable prices, there was no rise over time in per capita consumption of the adult in the working ages; and that with savings minimal (and disregarded for simplicity), total income (or net product of the nation) was the sum of all consumption (calculated by asigning 1.0 per adult in working ages, 0.50 to those below 15, and 0.75 to those 65 and over). Given these assumptions, and cumulation of inputs in children whose death occurred beyond year 0, we can calculate the cost as percentage of total current product. It works out to 2.68 percent for Egypt and 0.17 percent for the Netherlands (see line 18, cols. 3 and 6, in parentheses).

It is of interest to compare the results in Appendix Table 1 with those in Hansen's note (see footnote 19), which reports similar measures for India, compared with those for U.K. and USA, for 1931 and 1951 (see Appendix Table 2).

The comparison with the results here confirms the general orders of magnitude, and indicates how differences in the assumed child-adult consumption ratios affect the cost of childhood mortality expressed as percentage of total product. While we have assumed here the child-adult consumption ratio of 0.5, adults defined as people in the working ages (and with the consumption level per person of 65 and over set at 0.75), the resulting cost estimate for Egypt, at 2.7 percent, is close to that for India, either in 1931 or 1951, see lines 3-4, col. 1). And the introduction of a somewhat greater consumption allowance for the age group 10-14 in India does not change the cost estimate significantly (see lines 5-6,

Appendix Table 2

Major Results of Hansen's Calculations
of Costs of Childhood Deaths

	India	U.K.	USA
Deaths before age 15 % of Total Poulation	(1)	(2)	(3)
1. 1931	1.58	0.17	0.18
2. 1951	1.31	0.07	0.08
Costs of Childhood Deaths, Child-Adult Cons. Ratio Set at 0.5			
3. 1931	2.81	0.26	0.32
4. 1951	2.83	0.07	0.09
Cost of Childhood Deaths, Child-Adult Cons. Ratio Variable			
5. 1931	2.78	0.35	0.40
6. 1951	2.82	0.09	0.12

Notes

Taken or calculated from Tables 2 and 3, pp. 259-260, of the paper cited in footnote 19.

The cost of childhood deaths are expressed in percentages of the country's total product, equated to aggregate consumption.

The variable child-adult consumption ratios in lines 5 and 6 were as follows. For India, the ratio was set at 0.5 through age class 5-9, and at 0.8 for age class 10-14. For UK and USA, the ratios for the four successive age classes (the same as used here) were 0.6, 0.7, 0.8 and 0.9.

col. 1). In contrast, the introduction of higher child-adult consumption ratios for UK and US raises the cost estimates by a substantial proportion (from 0.26 to 0.35 in UK in 1931, and from 0.32 to 0.40 for USA, in the same year; the proportional changes in 1951 are almost as great, see columns 2 and 3, lines 3-6). Yet, even with the allowance for much higher consumption levels (relative to adults) of children in UK and USA, the relative costs of childhood deaths for India are still much greater in 1931 and 1951.

But if deaths of children represent an economic loss, because of past input of resources in their consumption that cannot be recovered, the same is true of the deaths of adults in working ages---so long as the surplus of their contribution to product beyond their own consumption fails to cover past historical costs incurred in raising them to productive ages. This is the rationale for Panel B-2 of Appendix Table 1, in which the cumulative input in past consumption (at 0.5 units until age 15, and at 1.0 through the successive ages, until 65) is compared with the cumulative total output credited to the adults. The latter output is estimated on two assumptions: (a) that it is the adult population of working age, 15-64, who produce the goods sufficient for their consumption and that of children under 15; (b) that within the working lifespan, output per person in age 15-24 just equals per capita consumption (i.e., 1.0); that the peak per capita output is a plateau in ages 35-44 and 45-54; and that per capita product in the intermediate age classes (i.e., 25-34 and 55-64) is at an arithmetic mean of the per capitas in the preceding and following age classes. This is clearly only a rough approximation to the life cycle of product per adult; but some such pattern is needed for a proper view of the time span within which the accumulated excess of output

over consumption begins to match the accumulated past input into consumption---for the proportion of population that dies and for whom full recovery of past costs cannot be attained.

The results of the estimates in Panel B-2 (for details of the procedure see the notes to the table) suggest that for Egypt the costs of mortality in the past-costs-recovering adult ages adds an item equivalent to 2 percent of product, raising the total past costs of childhood and early adult mortality to 4.6 percent (see lines 23-24, col. 4). For Netherlands, the addition, while smaller absolutely (0.64 percent), is far greater relative to cost of childhood mortality. This is due to the much greater weight of costs in col. 7, lines 19-22 than in col. 5 of lines 14-17; whereas total mortality (in percent of total population) in ages 15-44, of 0.1010 (see col. 5, lines 19-21) is not much lower than the corresponding total of 0.1173 for ages 0-14 (see line 18, col. 4).

Only further exploration, involving many more countries, would reveal whether the approximation to unrequited past costs represented by childhood and early adult mortality (introduced by the estimates in Panel B-2) is typical of less developed and developed countries respectively. But there is one aspect of the estimates underlying Panel B-2 that is likely to be typical, and deserves explicit note. If the adult population in working ages is assumed to produce sufficiently to cover both its own consumption and that of the population in ages 0-14, the average per head output for the adult working-age population of Egypt would have to be 76.7/57.0 = 1.346; whereas that for the Netherlands would have to be 78.65/64.0 = 1.229. In other words, the excess output demanded from adults in working ages in Egypt is proportionately greater than that demanded from the adult working ages in the Netherlands. This is a re-

flection of the dependency ratio which, whether or not we exclude dependency in ages of 65 and over (it was excluded by our assumption), is significantly greater in LDCs than in the DCs. The source lies in the higher ratio of children to adults in the working ages---which, for Egypt, amounted to 39.4/57.0 or 0.69; whereas in the Netherlands it was 29.3/64.0 or 0.46. It is the difference in these two ratios, combined with assumptions concerning the life cycle pattern of product per person within the working ages, that results in a contrast, at the peak plateau, between an output index of 1.664 for Egypt and 1.449 for the Netherlands. The implicit question is whether, given average levels of productivity, it is possible to muster such a high excess ratio; or whether, in order to achieve the latter, the whole average level of output in the productive ages would have to be lowered. If both the child-adult consumption ratios, and the proportions of children to working age adults are fixed, the adjustment may be either in the average level of the product, or in the pattern; and if the pattern is fixed, the adjustment is limited to the average level---involving implicitly the lowering of consumption for both children and adults.

Assuming for purposes of argument, that the results in both Panels B-1 and B-2 can be viewed as typical, what importance can be assigned to the indicated differences in the economic costs of childhood and early adult mortality between a less developed and more developed country? The answer can be suggested only after we take a brief account of the major omissions in the calculations, even allowing (as Hansen did) for a higher child-adult consumption ratio in a developed than in a less developed country.

The first major omission is neglect of the contribution of the mother's

engagement in pregnancy, birth, and the immediate burdens of care in infancy---the cost estimates here relating only to the consumption of goods and services by children. The weight of such omission would vary even among less developed countries depending on institutional practices and the role of women in productive activity; and it is not clear that differences in the weight of this particular cost component can be surmised in comparisons between less developed and developed countries (such costs always viewed as proportions of some over-all economic product magnitude). It clearly adds to the absolute costs of childhood mortality in both groups of countries; and thus adds to the accumulated costs that would have to be debited against the output in the early working ages (in estimating the costs of deaths at those age levels); but we have no basis here for any plausible comparisons.

The second omission is of a possible allowance for effects of growth in per capita product on the estimate of past costs embodied in economic loss from childhood (or young adult) mortality. If such growth does occur, the current burden is lessened since past consumption of children and younger adults is lower in proportion to <u>current</u> per person consumption; and hence in relation to current product. Here the difference in this respect between LDCs, with their higher and steadier rates of growth in per capita product, is clearly in favor of the latter---reducing more appreciably the proportion of past costs to current output. The magnitudes, and their differences as between LDCs and DCs, could be calculated using assumptions now used in Appendix Table 1, and introducing illustrative rates of past growth in per capita product.

The third omission, of potentially large magnitude, is that of foregone yields on past costs. These yields are possible even if we retain

the over-simplified assumption, which equates total product with total consumption, and thus neglects savings and capital completely. Even under such conditions, were it have been possible to dispense with past consumption of children or young adults whose deaths we are evaluating, the consumption of surviving adults would have been greater---with effects on productivity, which would be likely to have been greater in LDCs than in the DCs. This greater consumption foregone would have meant also greater productivity in the past---a loss that presumably would be in terms of current product, proportionately greater in LDCs than in the DCs. An alternative way to evaluate this omission is to allow for interest yield on past costs, and for the presence of capital returns in the economy. If for the sake of an illustration, we allow for an addition of returns on capital equal to a quarter of total consumption, and use of a 5% return rate on past consumption in children viewed as an investment, the application of these rates to cols. 2-3 and 5-6, lines 14-17 in Panel B-1, would yield an estimate of accumulated losses (to age 15) of 3.5014 in col. 3 for Egypt and of 0.2165 in col. 6 for the Netherlands---which with rough allowance for the rise in the total product demoninators by 25 percent---would work out to percentages of 3.528 and 0.207 respectively, a wider contrast than between the entries in parentheses in line 8, columns 3 and 6. This would also affect estimates of losses in the younger adult age classes in Panel B-2.

Finally, there is a question similar to that discussed in the text in connection with the focus of decision in the response of birth rates to the declines in death rates. Here the question is as to who bears the costs of childhood mortality, or the residual losses involved in the death of adults in the younger working ages. The question may not be relevant

for the economy as a whole. But if we are concerned with differential impacts of these losses on different economic and social groups within the population, the question of the identity of the bearer becomes relevant. Thus, in many developed countries, the state, in various ways, assumes part of the costs of children and young adults, i.e., part of their consumption--even if it may finance the activity from taxes on the income of adults and families, with the burden falling perhaps more on the higher income families. Thus, also, in many less developed countries, there may be sharing of such costs within the larger blood group, rather than the costs falling fully on the individual family unit. These comments suggest that the question of how the economic losses of mortality have been shared involves complicated effects of benefits and incidence of taxes in those developed societies where the state assumes increasing responsibility; of separation or jointness between the parental family and that of the next generation (bearing particularly on the locus of mortality costs for the younger age classes within the working lifespan); and of the relation between the single family, no matter how widely defined, and the wider blood-related group of which it may be a member.

It is not feasible here to explore the variety of omissions just indicated and to probe the interrelated and intricate questions that they suggest. The discussion of differential costs of mortality, like that of the offset-response of birth rates to declines in death rates, emphasizes that the analysis must take account of the wide variety of institutional economic and social groupings that frame the impact of losses involved in deaths at different ages or that shape the response of birth rates to declines in mortality. With inadequate data to indicate the differences in the framework among various groups of LDCs and

DCs, and with limited command over the monographic literature, the probing had to be limited and constrained by oversimplifying assumptions.

Despite these limitations, the discussion above is, I believe, sufficient to suggest the minimum relative magnitudes of the losses represented by deaths of children and younger adults---and the large differences in these losses between DCs and LDCs on the eve of the recent major downtrends of the death rates in LDCs. The proportionate losses represented by the death rates in the LDCs relating to children and the younger adults approximate at least 5 percent of the current product, compared with probably less than a fifth of that proportion in the developed countries; and reasonable adjustments of these shares, to take account of the omissions, could easily raise these minimal ratios to twice their indicated levels.

Comparisons of LDCs and DCs are only suggestive of comparisons within a less developed country between the mortality experience of the lower economic and social groups and that of the higher, more favorably situated. Yet given the possibility of substantial intra-LDC differences in mortality, associated in pre-1920s largely with disparities in economic and social status, one can reasonably assume that in those earlier decades the burden of economic losses of mortality were much heavier relative to the consumption and income levels of the lower income groups than they were for the upper economic and social groups; and that the convergence in death rates, and reduction in over-all levels, associated with the recent technological breakthroughs in control of death and of public health, meant also reduction in the inequality of the burden of relative losses of mortality at these different economic and social levels. And one must repeat, in conclusion, the comment made at the outset, concerning

the significance of death rates as indexes of morbidity; and of the possible direct effects of declining and converging morbidity rates on related disparities in productivity among the various economic and social groups within a less developed country as it benefits from declining mortality.

FOOTNOTES

[1]See "Demographic Aspects of the Size Distribution of Income," Economic Development and Cultural Change, vol. 25, no. 1, October 1976, pp. 1-94.

[2]We prefer to emphasize the total for LDCs, excluding China. The estimates for the latter for pre-1950s were always subject to debate; and there has been ever greater scarcity of data for China after the 1950s. Yet the estimated population for the country accounted for two-tenths of world population for 1975, and about three-tenths of the population total for the LDCs.

[3]The quinquennium 1970-75 and the estimate for 1975 are described even in the more recent UN sources as a projection; and we used the medium variant. But since estimates for this recent period could not deviate substantilly from the actual, at least with respect to change from the preceding two decades, we felt it justified to include them to form an observed 25 year span, 1950-1975.

[4]In his The Population of India and Pakistan (Princeton University Press, Princeton 1951), Kingsley Davis estimated the average annual death rate by decades from 1881-91 to 1931-41, showing a level of about 43 per thousand in the first three decades, a bulge in 1911-21 (associated with the influenza pandemic of 1918) to 48.6, and then a decline to 36.3 in 1921-31 and 31.3 in 1931-41 (p. 37). The estimated crude birth rates were set at between 46 and 49 in the first four of the six decades, and then at 46 in 1921-31 and 45 in 1931-41 (p. 69). This combination of relative constancy of the birth rate between 1920 and 1940, with a substantial decline in the death rate, is what we are assuming in the tentative calculation in the text.

[5]See particularly the paper for this Conference by Professor Samuel H. Preston on "Causes and Consequences of Mortality Declines in Less Developed Countries During the Twentieth Century" for a wide-ranging summary and bibliography. I also found a wealth of data and interpretation in the articles by Professor George H. Stolnitz, beginning with the two-part paper, "A Century of International Mortality Trends," Population Studies, vol. 9 and 10, July 1955 and July 1966 (reviewing the evidence to 1950) and concluding with the latest, "International Mortality Trends: Some Main Facts and Implications," in United Nations, The Population Debate, vol. I, New York 1975, pp. 220-236.

[6]A useful brief description of the assumptions underlying the projections, and the criteria of plausibility used in selecting them, is in United Nations, World Population Prospects as Assessed in 1963, New York 1966, Chapter 2, pp. 6-7. A wider review of the field is in Chapter XV, pp. 558-588 of United Nations, The Determinants and Consequences of Population Trends, Vol. I, New York 1973.

[7]It is possible to secure from United Nations, Demographic Yearbook 1957, the distribution of population among continents and sub-continents in 1920, as well as of the land area (including internal waters); and we find in Colin Clark, Conditions of Economic Progress, 3rd edit. London 1957, a distribution of land among major parts of the world, the land evaluated with respect to rainfall, temperature and other climatic factors that affect suitability for intensive cultivation (Table XXXIII, inset before p. 309). Comparing the large areas within the group that comprises the LDCs we find the following percentage distributions (LDCs, comprising the regions distinguished = 100)

7 (continued)

	Population (1920)	Total Land	Land in Standard Units
East and S.East Asia	77.0	24.8	29.4
Southwest Asia	3.7	8.2	1.3
Africa	11.7	39.4	31.8
Latin America	7.6	27.6	37.5

East and Southeast Asia in the first line is dominated by the Sinic and Hindic group; and the capacity shown to sustain enormous populations with a land endowment that is less than a third of that in the rest of the less developed world is striking.

[8]See Eduardo E. Arriaga and Kingsley Davis, "The Pattern of Mortality Change in Latin America," Demography, vol. 6 no. 3, August 1969, pp. 223-242.

[9]In 1920, of some 1,187 million population estimated in the less developed regions (defined as countries outside of Europe, North America, Japan, Soviet Union, Australia and New Zealand, and Temperate South America), only 69 million were living in places with population of 20,000 or more. While this low percentage of less than 6 was largely due to the dominance of Asia, a level of slightly over 10 percent was the highest shown for any sub-region. See, United Nations, Growth of the World's Urban and Rural Population, 1920-2000, New York, 1969, Tables 47-49, pp. 115-117.

[10]See United Nations, The Determinants and Consequences of Population Trends (first edition, New York 1953, p. 63).

[11]See the Davis monograph cited in footnote 4. The conversion ratio used in the text is described on p. 36 of the monograph. The data on children born and surviving to rural families in Punjab, in 1939, for various occupational class groups are in Table 26, p. 78, with discussion in the text (on p. 76) stressing some limitations of the data.

[12]The data are from Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition, Part 1, Washington, 1975. The series on gross and net reproduction rates are series B36-41, p. 53; those on crude birth rates are series B5-10, p. 49; and those on crude death rates are series B167-180, p. 59.

[13]See, e.g., the latest paper by I. Ajami, "Differential Fertility in Peasant Communities: A Study of Six Iranian Villages," Population Studies, vol. 30, no. 3, November 1976, pp. 453-463, and the literature cited therein, particularly the early paper by W. Stys, "The Influence of Economic Conditions on the Fertility of Peasant Women," Population Studies, vol. 11, no. 2, November 1957, pp. 136-148.

[14]For a brief discussion of the relation between the health revolution and economic development see the paper by the World Health Organization, "Health Trends and Prospects in Relation to Population and Development," in United Nations, The Population Debate, vol. 1, pp. 573-597. The same paper contains some discussion of the relation between the decline in infant mortality and the birth rate.

[15]In this connection one may refer to two papers on population growth and income distribution, in the United Nations volume, Population Debate, vol. 1 cited in footnote 14 above. The first, by Dharam P. Ghai, "Population Growth, Labour Absorption, and Income Distribution," (pp. 502-509) summarizes the conclusions by listing in Table 2 (p. 509) the effects of population growth on income distribution--under two major headings of "high fertility" and "reduced fertility"--with the levels and trends of mortality not mentioned. In the other paper, by H.W. Singer, "Income Distribution and Population Growth," (pp. 510-517), there is explicit

15 (continued)

mention of lower mortality as "a necessary first step towards achieving the more desirable low birth rate/low death rate type of equilibrium..." (p. 516). But this statement is followed by considering effects of a more equal distribution on death rates; with no discussion of the reverse, the possible effects of declines in mortality on the income distribution in the LDCs. Yet with all the interest in the latter, the possible effects of the trends in mortality rather than in fertility that dominated the demographic changes in the LDCs in the last few decades seem to be neglected.

[16]Much of the literature on the response of fertility to mortality declines concentrates on the response of families to the actually incurred death of a child (or children) and the observed reaction. See in this connection the Preston paper cited in footnote 5 above, the paper for this conference by Professor Yoram Ben Porath on "Fertility and Child Mortality--Issues in the Demographic Transition of a Migrant Population." Of particular interest are also Professor Preston's paper "Health Programs and Population Growth," Population and Development Review, vol. 1, no. 2, December 1975, pp. 189-200; and his summary Introduction to the volume of Proceedings of the CICRED Seminar on Infant Mortality in Relation to the Level of Fertility (the Proceedings were not available to me at the time of writing). For lack of familiarity with the details of most of the sample studies involved, one cannot judge whether the failure to "replace" children's mortality completely can be translated into an effective absence of a desired number of children as a target firm enough to explain the failure to reduce the birth rate in response to a perceived decline in mortality. There is an apparent lack of symmetry between a situation in which birth frequency has to be raised in an active response to the loss of a child and a situation in which births have to be reduced in response to an increased

16 (continued)

number of surviving children.

At any rate, it seemed of interest to stress in the brief discussion here aspects of lag, of perception of mortality declines, and of persistence of an excess in the possible number of desired surviving children over that actually resulting through much of the early phase of the downtrend in mortality in the LDCs.

[17]The death rates derived for 0-4 population in lines 8 and 17 exceed the crude death rates for total population by factors of 2.4 to 3.2 in 1950-55 and 2.7 to 3.6 in 1970-75. Multiplying these ratios by the proportion of 0-4 to total population, averaged over each of the two quinquennia, we can derive the proportions of deaths of children 0-4 to all deaths, which would range from well over 40 percent to 50 percent or more. The direct data on distribution of deaths by age for various countries in the United Nations Demographic Yearbook (various years) suggest proportions for recent years and back to the 1950s, of between 40 and somewhat over 50 percent. The agreement cannot be checked fully, because of scarcity of data on distribution of deaths by age; and the indication that in many countries the deaths of infants are particularly under-reported (a bias that would affect death rates for 0-4 population much more than total crude death rates). For the present illustrative purposes, further effort at assembling data on deaths by age, or using direct information on age-specific death rates for LDCs, did not seem worthwhile. A more intensive study of the effects of declines in death rates would warrant such further effort.

[18]See a recent paper by John C. Caldwell, "Toward a Restatement of Demographic Transition Theory,", Population and Development Review, vol. 2 nos 3-4, September and December 1976, pp. 321-366, which stresses the "flow from the younger generation to the older" in pretransition society and the reverse flow in the post-transition, nucleated families.

[19]This choice follows the approach in an earlier brief paper by W. Lee Hansen, "A Note on the Cost of Children's Mortality," The Journal of Political Economy, vol. LXV, no. 3, June 1957, pp. 257-62. This paper was stimulated by a desire to correct an exaggerated and erroneous estimate of the proportional cost of children's mortality made rather casually for India by D. Ghosh, who set this cost as high as 22.5 percent of national income (compared with Hansen's medium estimate of less than 3 percent). Hansen's note employed somewhat more elaborate assumptions than are followed and used data for countries and dates other than those used here. But as will be seen below, the general order of conclusions, when limited to children's mortality, is about the same.

The topic here is clearly a part of the wider theme of the economics of family formation in the demographic transition, subject of a brief and illuminating paper by Frank Lorimer, "The Economics of Family Formation under Different Conditions," United Nations, World Population Conference, 1965, volume II, New York 1967, pp. 92-95.